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QUICKSILVER IN OREGON

By

HOWARD C. BROOKS
Geologist

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FOREWORD

Oregon's metal-mining industry in recent years has essentially been one of strategic mineral production. A major contributor to the state's mineral production and a strategic mineral is quicksilver. The liquid metal is more widely distributed in the state than any other valuable metallic mineral. This is probably because of the close association of quicksilver with volcanism and, as is generally known, Oregon has a greater area of volcanics than any other state except Hawaii. Several major mining districts at widespread places have been delineated, and five mines have produced important quantities of metal. The prospects for further mining of quicksilver and the discovery of new ore deposits appear to be good.

Strategic minerals are those which are absolutely necessary for production of metals needed to give special properties to steel (for armor, jackets for armor-piercing shells, for tools and dies, and the like) and for other uses for which there are no satisfactory substitutes. These minerals are required for the successful conduct of a war - either hot or cold. Unavailability of strategic minerals, even those which are needed in relatively minute amounts, can have serious national consequences out of all proportion to their dollar value.

It has been the custom of the United States to rely on imports of the strategic minerals during times of peace or periods of relative economic stability, but during war time, when sea lanes are closed or hazardous, to offer incentive prices for supplies from domestic sources. The result has been a market price for the "strategics" that has fluctuated widely. The author of this bulletin has referred to this situation as a "yo-yo policy." Many times the fluctuations vary rapidly, with the result that greater investments are made in exploring for or developing the strategics than the market can reasonably support (in the case of a rapidly rising price), or it is impossible to amortize investments (in the case of a rapidly dropping market). The long-range result of this is three-fold. The prospector finds it difficult to know where to concentrate his efforts in his search for minerals and therefore becomes frustrated and loses interest; the responsible mining company cannot justify a domestic exploration program or long-range investments and therefore avoids the strategic field; and the investor views the strategics as a long-shot gamble and therefore shows little interest, or he requires returns or security far greater than the usual investment, with the result that little money is available.

The answer, of course, is a National Minerals Policy that will bring some stability to this "Achilles heel" in the national economy. But, surprisingly and inconceivably, this has never been forthcoming even though it has been repeatedly urged by the mineral industry and the Western Governors Conference. The only precaution that the Federal planners have ever taken to insure a continuing supply of strategic minerals was in the 1950's, when a national stockpile, based largely on imports, was accumulated. And now we see the domestic suppliers to the stockpile called before Congressional committees and subjected to various investigations! They also must face the threat of having the stockpile accumulations dumped on an already depressed market.

The result of this, of course, is a dead strategic minerals industry in the United States with a complete dependence on overseas sources. A by-product is the discontinuance of prospecting and developing and a loss of any ore that might have been left at the time a mine was forced to close.

Of all the strategics, none has had a more spotty history than quicksilver. Today the market is depressed and there are only four mines operating in all of the United States. It seems likely that two of these will close before the year is out. Oregon has not had a major producer in operation for over a year and prospecting is at a standstill. But history has taught us that a time will come when the demand for quicksilver will become critical. Then this bulletin will prove invaluable. It could well be that this record may stimulate interest even now, since it is a compendium that deserves study. There is the possibility also that works such as this will encourage the Federal Government to enunciate a National Minerals Policy.

Hollis M. Dole
Director

February 14, 1963

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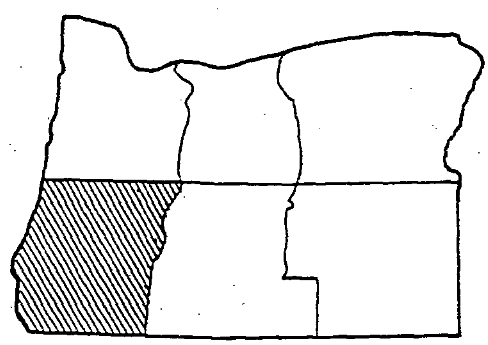

Chapter 1. SOUTHWESTERN OREGON

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from deposits in the Meadows area west of Trail, where the deposits indiscriminately cross the boundary between the older and younger rocks.

Within the Klamath Mountains most of the known deposits in the quicksilver belt occur in rocks of the Triassic Applegate Group. Exceptions are one deposit in granite, one in sheared serpentine, and various minor occurrences in Paleozoic schists of the Siskiyou Mountains.

West of the quicksilver belt, in Josephine and Curry Counties, quicksilver deposits are widely scattered and of minor importance. They occur chiefly in Jurassic or Cretaceous volcanic and sedimentary rocks. In the Red Flat area of Curry County, cinnabar is associated with peridotite and serpentine.

Description of the Quicksilver Deposits

BLACK BUTTE AREA

The Black Butte area is in southern Lane County in Tps. 22 and 23 S., R. 3 W., near the head of the Coast Fork of the Willamette River (figure 10), about 17 miles by road south of Cottage Grove on the north slope of the Calapooya Mountains. The area is covered by the topographic map of the Anlauf quadrangle. Located therein are the Black Butte mine, the Woodard prospects, and the Hobart Butte deposit.

Rocks underlying the area are predominantly hypersthene-augite andesites of the upper or dominantly lava facies of the Calapooya Formation (Wells and Waters, 1934, p. 11), which has been shown to be the equivalent of the Fisher Formation (Hoover, 1959). The quicksilver deposits follow normal faults along which andesites have been extensively altered over broad areas by hydrothermal solutions. Rugged crags, sustained by thickly massed veinlets of silica-carbonate and deposits of silicified rock commonly mark the fault zones. On the surface, brown iron ribs produced by weathering of silica-carbonate veinlets are almost omnipresent, increasing in number near the faults. Recorded production from the area has been 16,094 flasks, all from the Black Butte mine.

BLACK BUTTE MINE

Location: The property consists of about 1,000 acres in secs. 8, 9, 16, and 17, T. 23 S., R. 3 W. The workings are in the NW$\frac{1}{4}$ sec. 16 and enter the northwest slope of Black Butte, which is a sharp-crested hill of 2,800 feet elevation.

Owner: Quicksilver Syndicate, Daniel I. Mills, Pres., Black Butte, Oregon.

Production: U. S. Bureau of Mines production figures are shown in table 3.

History: The Black Butte mine, Oregon's fourth largest quicksilver producer, was discovered in 1890 by S. P. Garoutte. Although a 40-ton-per-day Scott-Hutner furnace was installed, little development work was done until 1897, when the Black Butte Quicksilver Mining Co. was organized and took over the property. By 1908, under the direction of W. B. Dennis, some 15,000 feet of development work was done on 100, 200, 300, and 400 foot levels. Dennis also increased the capacity of the Scott-Hutner furnace with an artificial downdraft system.

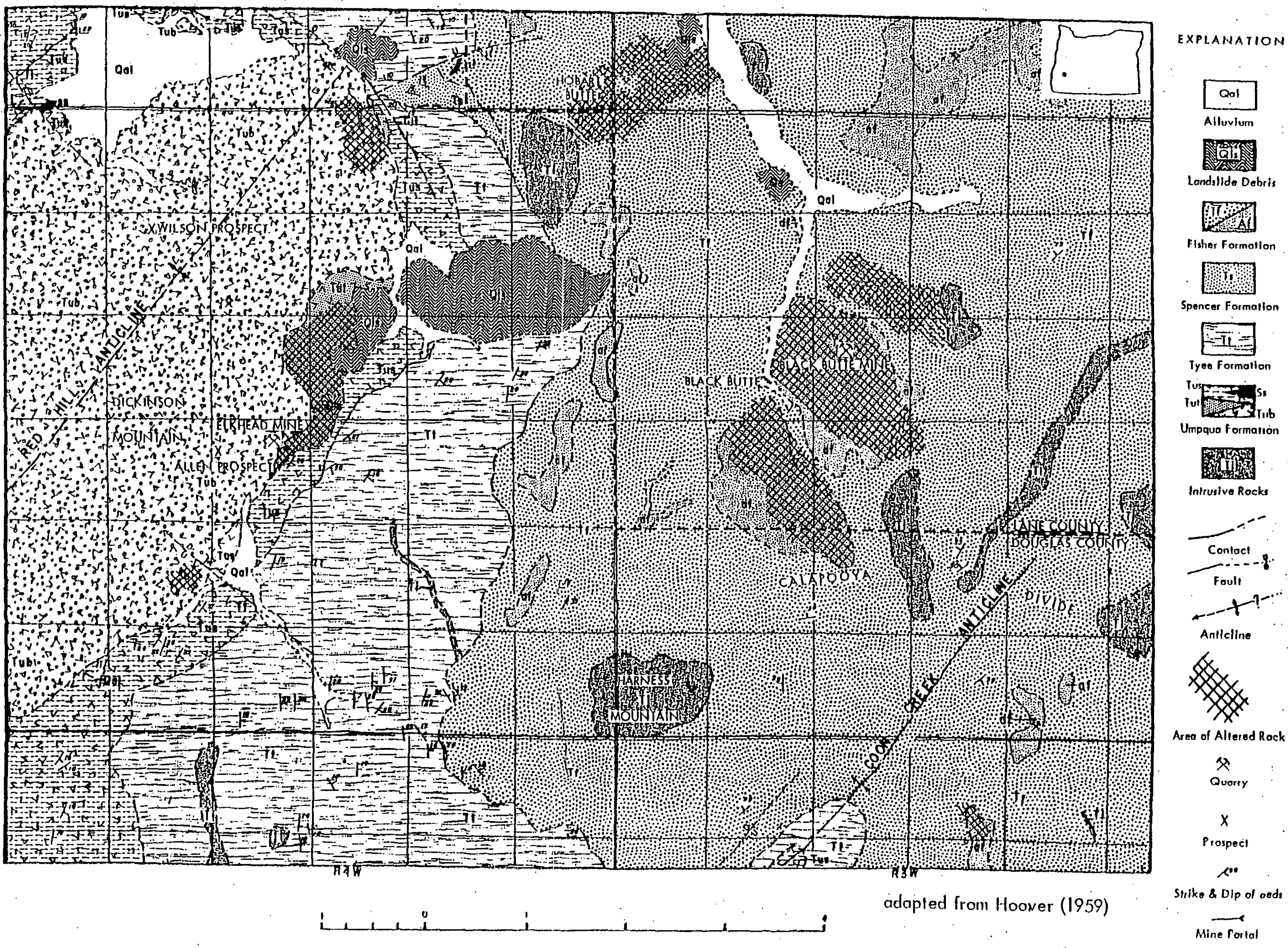
From 1909 until 1916 the mine was closed, owing to the depressed price of quicksilver.

World War I saw rising prices and the mine was reopened by a New York company under the management of Earl B. Crane. A flotation unit and a redesigned Scott furnace were used from 1916 to 1919. After the war, declining prices forced a shutdown.

In 1927 the property was purchased by the Quicksilver Syndicate controlled by Robert M. Betts. By 1929 two 4-by-60-foot rotary furnaces had been installed, giving the mill a capacity of 150 tons per day. The Black Butte was operated more or less continuously from 1927 to 1942 by the Quicksilver Syndicate. During this time levels were established at 500, 600, 900, 1100, 1300, and 1600 feet. After retreating old furnace tailings, the mine was closed in March 1943 and remained idle until 1956.

In 1956 and 1957 the mine was under lease to the Mercury & Chemicals Corp. of New York. With the assistance of a DMEA loan they explored, developed, and furnaced ore from the 900 and 1,100 foot levels.

Development: The Black Butte mine has been developed by 8 adit levels distributed over a vertical distance of about 1,300 feet (see plate 3 in pocket). The principal ore shoot of the mine has been worked from surface



adapted from Hoover (1959)

Figure 10. Geologic map of the Black Butte and Elkhead areas.

outcrops to the 1,100-foot level, a vertical distance of about 850 feet. The apex of the ore zone is 1,500 feet in elevation above the furnace level.

The workings required no timbering except in manways and chutes and when visited by the writer in the summer of 1959 most of the mine workings were still open, even though little maintenance work has been done since 1943. Ore was mined from large shrinkage stopes from adit levels, making mining costs much less than at most other quicksilver mines (see figure 11).

Before 1927, ore was carried to the mill by an aerial tramway from the 400-foot level. In 1927 the tramway head house was moved to the 900-foot level and a raise was driven to the 500-foot level. This tramway had 110 buckets and each bucket carried 90 pounds of crushed ore. The aerial tramway was abandoned in 1939 and ore was brought down inside the mine to the Dennis Creek (1,600) level, crushed, and trammed in mine cars to the furnace plant.

Table 3. Recorded Production of the Black Butte Quicksilver Mine*

Year	Treated Furnace (Short Tons)	Flasks
1900	-	200
1901	-	75
1905	-	42
1908	4,100	323
1909	231	486
1916	5,746	282
1917	12,726	380
1918	-	382
1919	-	210
1927	8,841	150
1928	26,248	999
1929	39,901	1,312
1930	49,419	1,549
1931	45,439	1,618
1932	28,667	912
1933	20,455	607
1934	23,086	1,273
1935	22,345	919
1936	21,075	788
1937	19,637	895
1938	19,701	803
1939	17,456	540
1940	18,767	439
1941	19,733	292
1942	2,678	208
1943	2,282	38
1951)	-	26
1951)	-	4
1956	2,284	45
1957	7,752	297
	418,569	16,094

*Source: U. S. Bureau of Mines

Geology: The following descriptions of the geology and the ore shoots and the suggestions for future exploration are quoted from Waters (1945).

Geology at the Black Butte Mine

"Black Butte is composed of andesitic lavas, tuffs, and breccias of the Calapooya Formation (Tertiary). At a few places in the mine these volcanic rocks have been injected by dikes and irregular intrusive masses of basalt and andesite. A single felsite dike is exposed in the lowest adit.

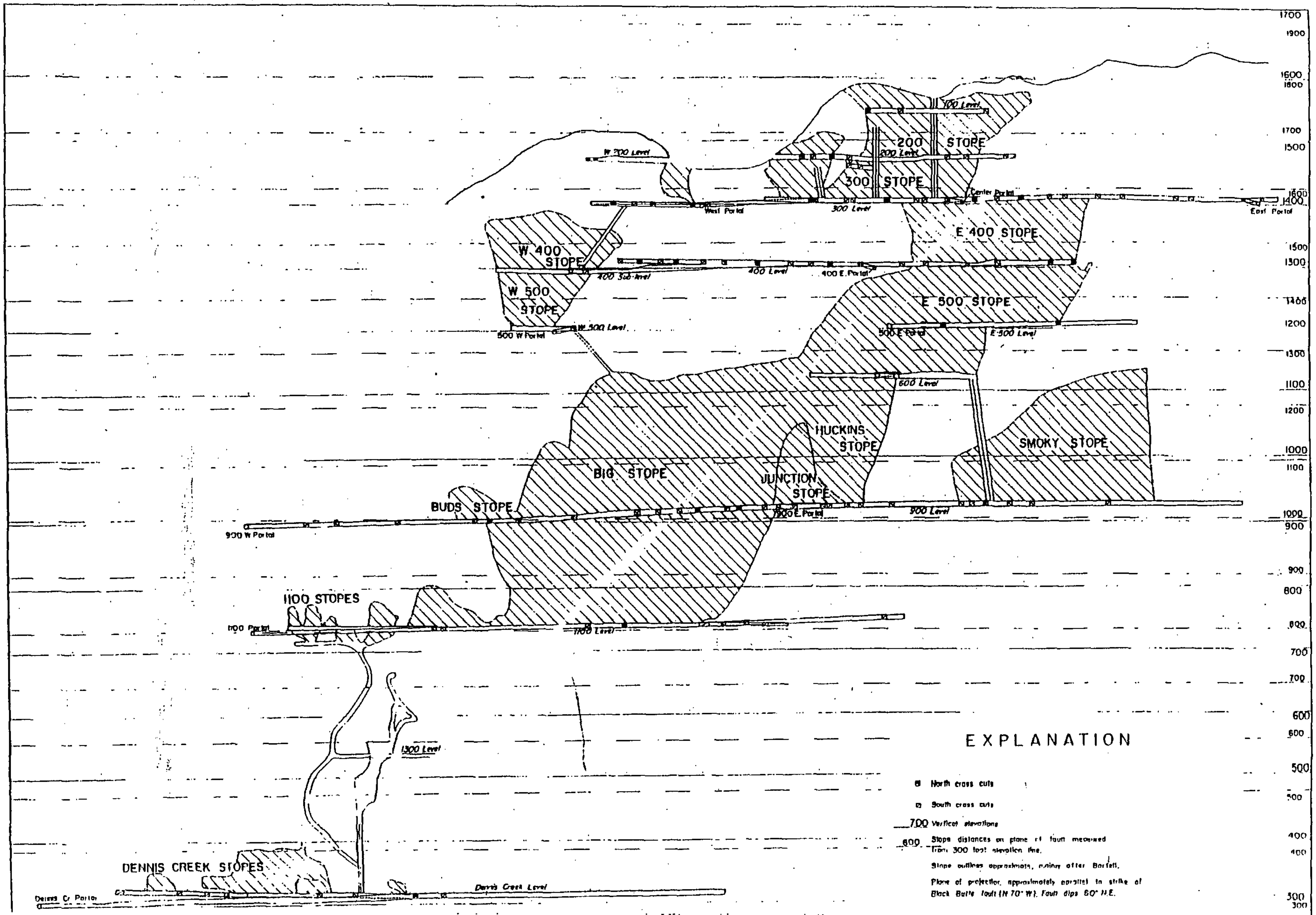
"The top of Black Butte coincides roughly with the trace of a normal fault which, though containing warps and irregularities, strikes approximately N. 70° W. and dips about 58° NE. Roughly parallel with this fault are numerous smaller faults, distributed through a considerable zone both on the hanging wall and footwall sides of the main fault.

"Hydrothermal solutions, rising along these faults and along bedding planes, joints, and other permeable zones in the volcanic rocks, have profoundly altered the andesitic lavas and pyroclastics. Much of the rock of the mountain has been so bleached and softened that its original character is almost unrecognizable. In most areas the altered rock is composed largely of carbonates and clay minerals, with variable amounts of chalcedony and quartz, and minor amounts of opal, chlorite, sericite, pyrite, and marcasite. Irregular veinlets composed of chalcedony and carbonates cut the altered rock, and are particularly numerous near the faults. The veinlets contain abundant siderite and some iron sulfides. Since the cinnabar was introduced during the last stages of silicification, the iron-stained rubble derived from the oxidation of the veinlets is a guide in prospecting.

"Locally the rock has been completely silicified. Fault breccia and gouge along the main fault have in many places been replaced by solid masses of chalcedony. These silicified rocks occur not only along the main fault but large bodies of silicified, bedded tuffs also occur in the Smoky Stope area more than 100 feet north of the main fault. The silicified rock is ore-bearing in many parts of the mine.

"During the last stages of mineralization, much calcite was introduced as veinlets and impregnations. A large body of vein calcite was deposited along the main fault between the western part of the 900 level and the 1,550 or Dennis Creek level, this body of coarsely crystalline vein calcite is over 30 feet thick and has been mined and marketed for chicken grits.

"Though the main epoch of faulting preceeded the hydrothermal alteration and ore deposition, there has also been some post-mineral movement, particularly along the main fault. The post-mineral movement has in many places polished fault surfaces that are well exposed as "walls" in the drifts and stopes.



A. C. Waters, 1942

Figure 11. Vertical longitudinal projection of the Black Butte mine.

Ore Shoots of the Black Butte Mine

"Ore shoots along the Black Butte fault: Most of the production of the Black Butte mine has come from a single continuous ore shoot along the Black Butte fault. This ore shoot has been exploited by the Big stope, and by stopes in the eastern part of the mine above the 600 level. Ore was mined from the top of the mountain to the 1,100 level, a vertical distance of 850 feet. The ore shoot, which has indefinite walls, rakes to the northwest. The greatest dimension of the stopes, measured on the fault surface in the direction of rake, is about 1,200 feet. The width of the mined area, taken at right angles to the rake, varies greatly but averages about 300 feet. The ore shoot is from 3 to 40 feet thick.

"Within this ore shoot, cinnabar and small amounts of metacinnabar and native quicksilver occur as specks, blebs, and short discontinuous veinlets in and adjacent to the brecciated and altered rock along the Black Butte fault. The tenor of the ore varies erratically; in general it is richest in the more thoroughly silicified rocks of the fault zone, where it occurs chiefly as discontinuous veinlets and blebs. Some silicified rock, however, is almost barren. After silicification, renewed movement shattered the silicified rock locally and left other parts relatively unfractured. Cinnabar and accompanying minerals were then deposited in the openings of the shattered rock. Minable ore also occurs locally in the clayey and carbonatized but unsilicified rocks in and adjacent to the fault. Here the cinnabar is chiefly disseminated in minute specks through the altered rock, though some is in short veinlets associated with siderite and chalcedony.

"Although some very rich ore has been mined, especially from the highly veined parts of the silicified rock, most ore was of very low grade. The average grade of rock mined from this ore shoot appears to be not more than 4 pounds per ton. Permeable zones, due to shattering of the silicified rock, were obviously the favored sites for ore deposition.

"The stope that extends above and below the west end of the 400 level is on the Black Butte fault, in ore of the same nature as that in the ore shoot just described. Unmined low-grade ore of the same general character lies between the two stopes on the 400 level. This ore was not extracted because the raise connecting the 400 level with lower levels was plugged.

"Ore shoots in bedded tuffs: The Smoky stope, at the east end of the 900 level, and the stopes at the west end of the 1,100 level have been opened in ore shoots that lie in bedded tuffs more than 100 feet northeast of the Black Butte fault.

"The Smoky stope ore shoot lies at the contact between two tuff beds. The upper one is a coarse, purple to red-brown, andesite tuff containing fragments up to 1 inch in diameter. The fragments are pumiceous andesite set in a lighter-colored matrix of fine andesite fragments and pumice dust. Associated with this tuff in the west end of the Smoky stope, about 40 feet above the 900 level, is a lava flow which has been converted into a beautiful replacement breccia by hydrothermal solutions. Similar altered lava at the east end of the 900 level drift may also be a part of this unit, but its exact relationship is obscured because it is separated from the rest of the main Smoky stope area by a northeast-trending cross fault, which forms the east end of the Smoky stope.

"The basal portion of the purple-brown tuff has been thoroughly silicified locally, especially along the 900 level, and the best ore occurs in and directly beneath the silicified purple-brown tuff.

"The purple-brown tuff is underlain by a highly altered white to light-buff tuff. This white tuff, which is composed largely of carbonates and clay in the Smoky stope, is more silicified toward the west and eventually passes into a hard, cream-colored, sugary-textured rock composed largely of chalcedony. The cinnabar gradually diminishes and disappears westward as the silicification increases.

"The ore-bearing contact between the white and purple-brown tuff strikes about N. 80° W. and dips 30° to 35° NE. However, the overall inclination of the ore-bearing zone, both in the mined-out portion above the 800 level and in its downward projection as determined by drilling, is 45° to 50°. This discordance is due to the fact that the ore-bearing contact is repeatedly broken and offset by small faults with downthrow to the northeast. Some of these faults are premineral, others postmineral.

"The stopes at the west end of the 1,100 level have been opened in partially silicified, fine-grained tuffs interstratified between coarse volcanic breccias.

"Ore shoots along vertical fractures in andesite: The Dennis Creek level is mainly in a thick flow of porphyritic andesite. This andesite is cut, 250 to 300 feet north of the Black Butte fault, by a series of steeply dipping fractures that strike roughly parallel with the fault. For some distance from each fracture the lava is irregularly altered, and cinnabar has been deposited as veinlets and disseminations in the altered rock. The ore is of very low grade.

Suggestions for Future Exploration

"Except for a limited area of blocked-out ore on the 400 level, the stope area along the Black Butte fault appears to be exhausted of all but submarginal ore. On the other hand, the downward continuation of the ore in bedded tuffs below the Smoky stope has been indicated by drilling. The four holes drilled have delimited the western limit of the ore body at depth, but have not delimited either its eastern limit or its bottom. Above the 900 level, the Smoky ore shoot ends on the east against a prominent cross fault that shows postmineral movement. The ground to the east of the cross fault has not been well prospected. Drilling to the east would establish whether or not the same contact (purple-brown tuff--white altered tuff) is also mineralized.

"Very little exploration has been done along the continuation of the Black Butte fault to the east of the Big stope. The zone of hydrothermal alteration continues in this direction for at least half a mile, as shown by float and an occasional outcrop of silicified rock. Inclined drilling into the ridge in this area would test not only the possibility of a second ore shoot along the Black Butte fault, but also the possibility of bedded ore shoots, such as the Smoky ore shoot in the hanging wall.

"Although the hanging-wall area has been well explored by numerous adits in the main area of the mine, only a few short crosscuts penetrate the footwall. The possibilities of the footwall area could be thoroughly tested by drilling flat to low-pitching holes to the southwest from the 900 and 400 levels."

WOODARD PROSPECTS

Location: Secs. 17, 20, 21, and 28, T. 23 S., R. 3 W., on Little Baldy Butte and Cinnabar Mountain, which flank Black Butte on the south and southwest.

Owner: J. F. Woodard.

Production: None.

Development: Development includes many pits and trenches, four adits containing more than 600 feet of workings on the north face of Little Baldy Butte, and a 200-foot adit on Cinnabar Mountain. Most of this work was done by Woodard during many years of prospecting the area. Of 287 samples taken from these many prospects by the U.S. Bureau of Mines in 1942, none contained more than a trace of quicksilver. Woodard reports, however, that assays in excess of 15 pounds per ton of quicksilver had been obtained.

Geology: Jagged crags and high, steep-walled outcrops of altered rocks similar to those forming the crest of Black Butte are well developed on Cinnabar Mountain and Little Baldy Butte. The numerous workings explore altered andesitic lavas that mark the outcrop of a fault zone trending N. 15° to 35° W. According to Wells and Waters (1934, p. 33), this fault zone is at least 2 miles long and a quarter of a mile wide.

HOBART BUTTE

Cinnabar is occasionally reported as occurring in the high-alumina clay deposit on and near Hobart Butte. From the principal quarry, lying near the crest of the Butte in the SW$\frac{1}{4}$ sec. 31, T. 22 S., R. 3 W. and about 3 miles airline northwest of the Black Butte mine, 12,000 to 15,000 tons of clay were shipped to a brick plant at Willamina during the 1930's (Oregon Department of Geology and Mineral Industries 1951, p. 90-91). A substantial tonnage of the clay was blocked out by a joint drilling program of the U.S. Bureau of Mines and U.S. Geological Survey in 1943 (Allen, Loofbourow, and Nichols, 1951). Quicksilver was not reported in any of their analyses. It is thought that perhaps realgar, the arsenic sulfide which is rarely found in the clay, has, on occasion, been mistakenly identified as cinnabar. On the other hand, cinnabar may reasonably be expected to occur here, since the Butte lies within a district of rather widespread hydrothermal alteration and cinnabar mineralization.

The rocks from which the clay has derived are thought to have been volcanic breccias, tuffs, conglomerates, lava flows, and mud flows of the Fisher Formation.

ELKHEAD AREA

The Elkhead area extends along Elk Creek south of Scotts Valley in T. 23 S., R. 4 W., Douglas County, about 4 miles west of the Black Butte area (see figure 10). The topographic map of the Anlauf quadrangle covers